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H04B 1/06

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U1S S2196

(56) Documents cited
EP 0189622 A1 WO 91/07029 A1 WO 89/12881 A1
WO 87/04309 A1

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(54) **Storage of received programme segments in RAM**

(57) A broadcast programme receiver especially a radio (10) is equipped with random access memory (32) for recording the programme signal in digital form, means to retrieve (34) and play (18) the stored signal and a microprocessor (14) to control the storage under user commands enabling definition of programme material to be stored and also retrieval of programme signals for reproduction with a timed delay. RDS may be used to identify programme segments to be recorded.

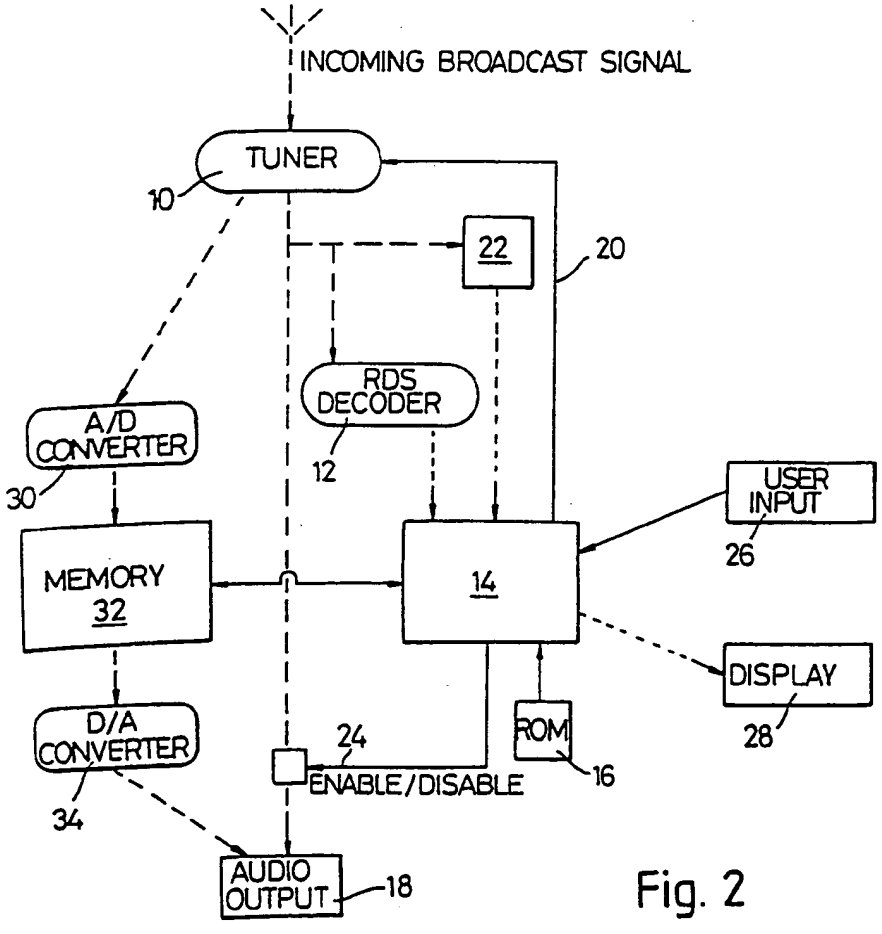

Fig. 2

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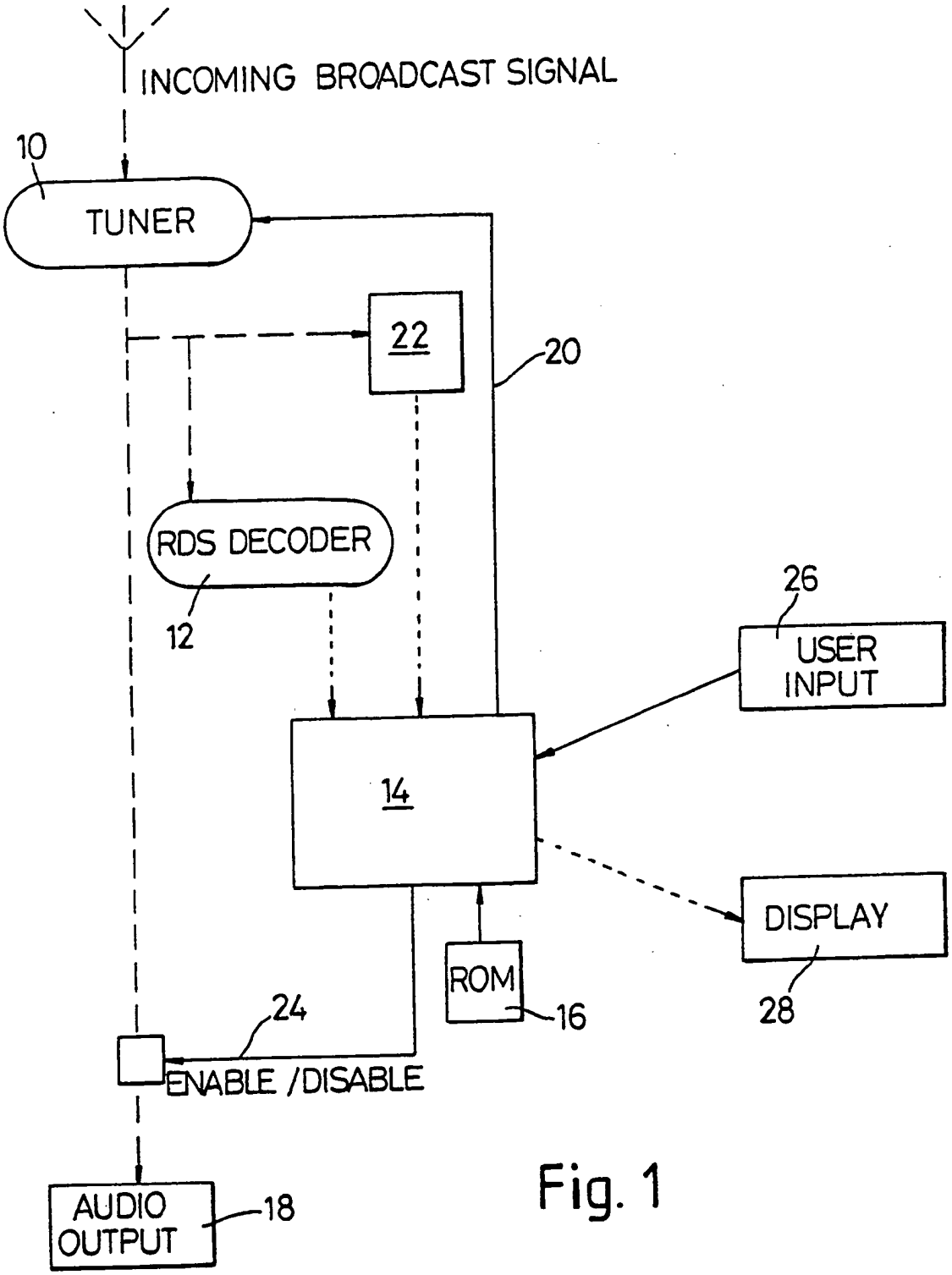
INCOMING BROADCAST SIGNAL
10
TUNER
22
20
RDS DECODER
12
26
USER INPUT
14
DISPLAY
28
ROM
16
24
ENABLE /DISABLE
AUDIO OUTPUT
18

Fig. 1

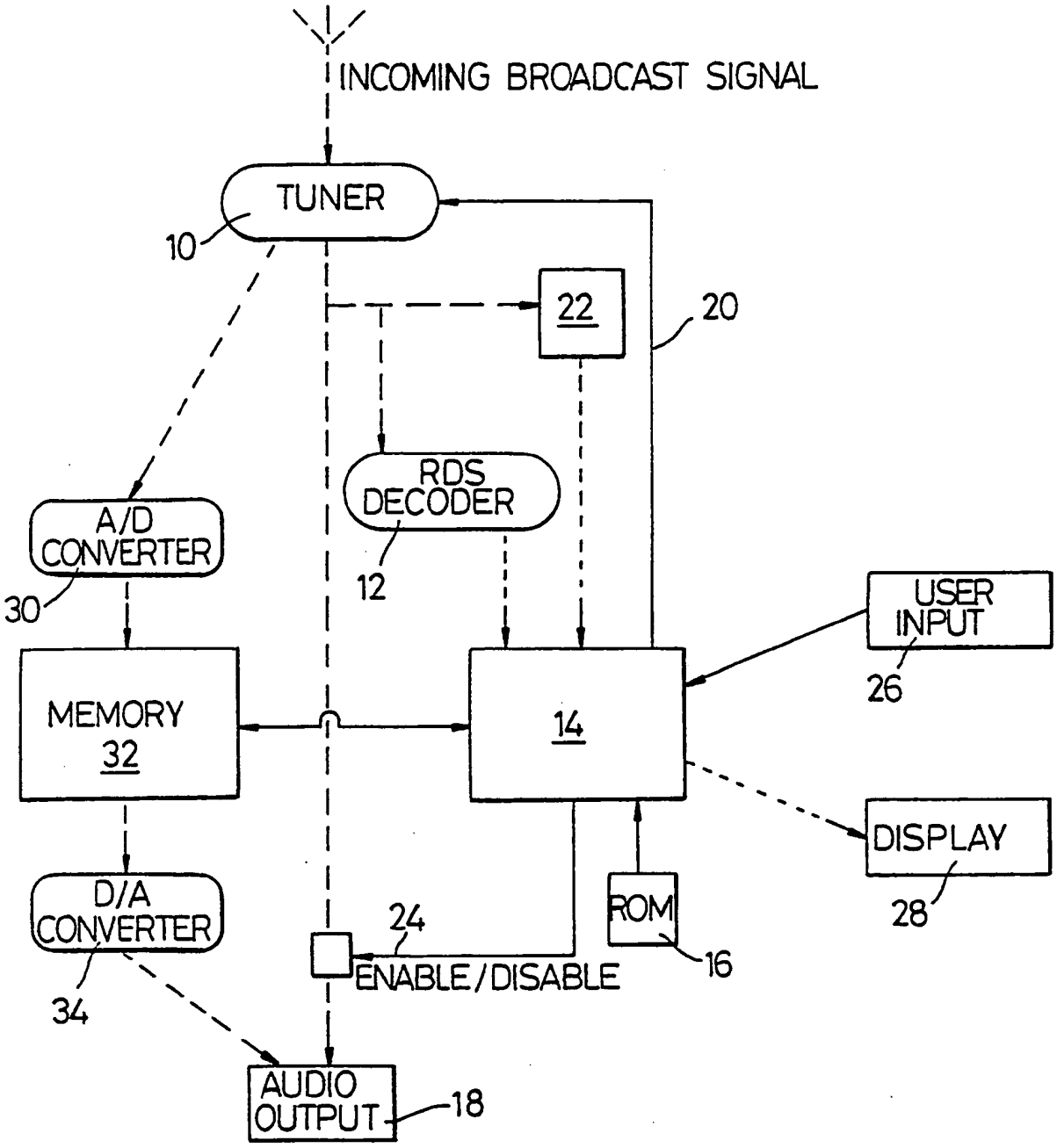
INCOMING BROADCAST SIGNAL
TUNER
10
22
20
RDS DECODER
12
A/D CONVERTER
30
USER INPUT
26
MEMORY 32
14
DISPLAY
28
D/A CONVERTER
34
24
ENABLE/DISABLE
ROM
16
AUDIO OUTPUT
18

Fig. 2

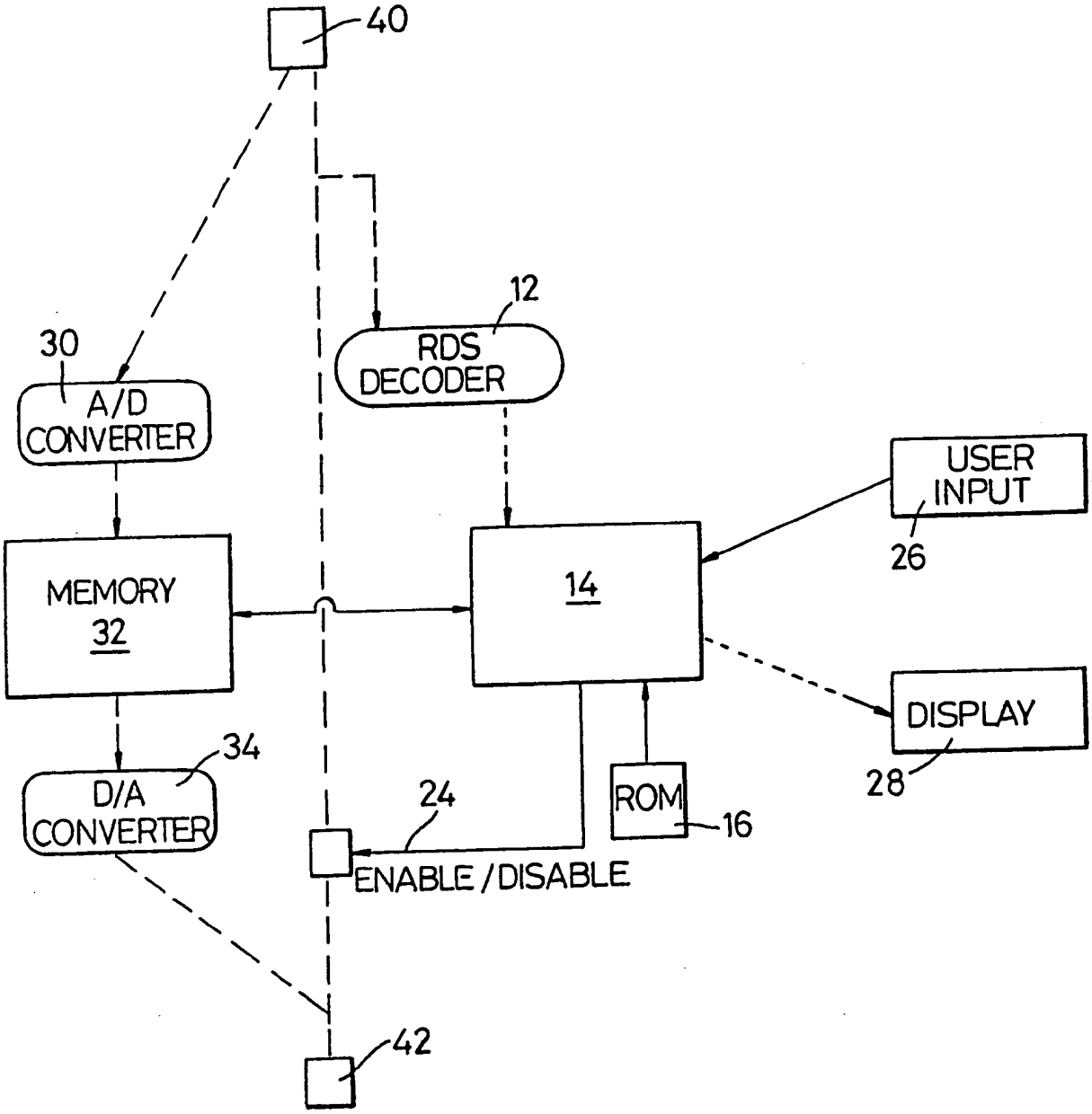
40
12
30
RDS
DECODER
A/D
CONVERTER
USER
INPUT
26
MEMORY
32
14
DISPLAY
28
34
D/A
CONVERTER
24
ROM
16
ENABLE / DISABLE
42

Fig. 3

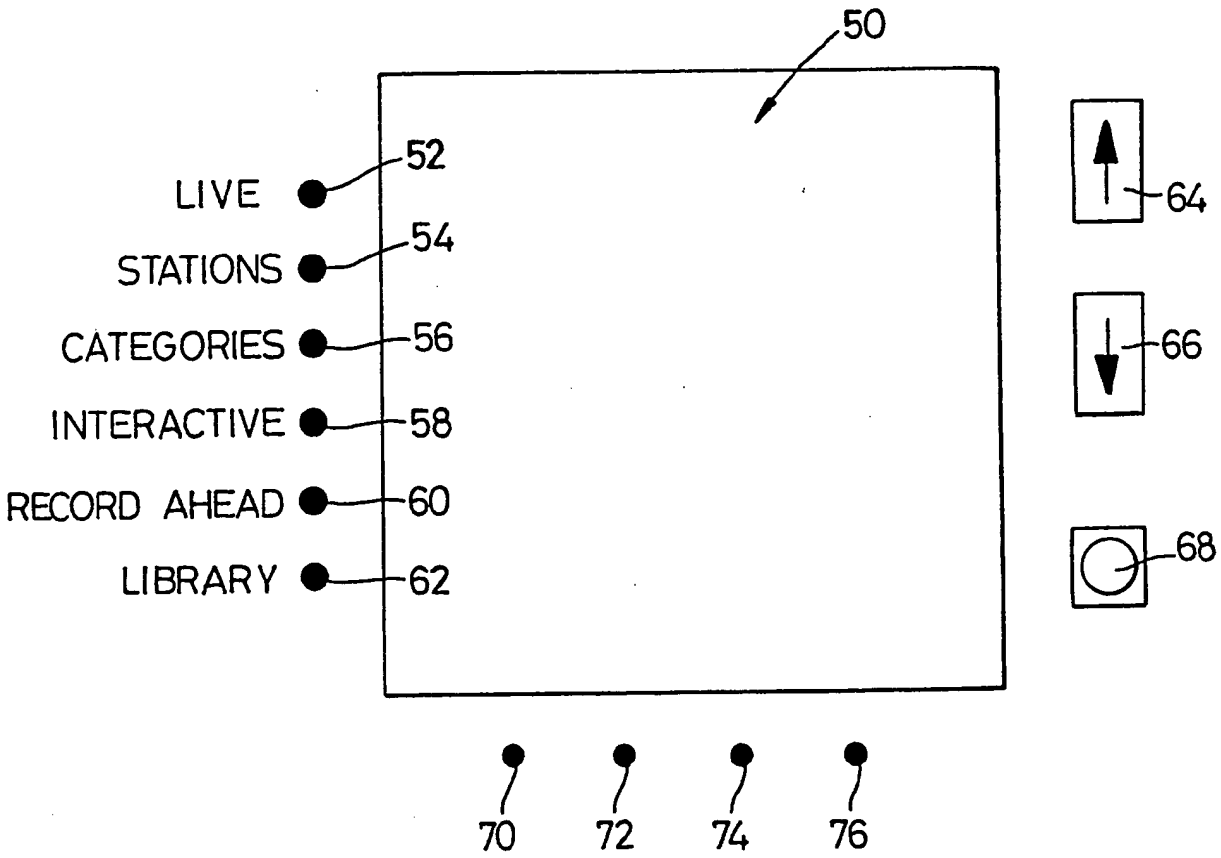
50
LIVE
52
STATIONS
54
CATEGORIES
56
INTERACTIVE
58
RECORD AHEAD
60
LIBRARY
62
64
66
68
70
72
74
76

Fig. 4

INTERACTIVE BROADCAST RECEPTION

This invention relates to apparatus for the reception and/or subsequent manipulation of broadcast programmes. As will be explained below it is particularly envisaged that the invention would be embodied in a radio receiver to provide functions going beyond those currently available. However in its broader forms the invention could be embodied in apparatus making use of a signal received by a separate receiver. It is also conceivable that the invention could be implemented for television broadcasts.

FM radio transmissions carry a monophonic audio signal from 0-15kHz and stereo difference signals between 23 and 53kHz. Transmissions in stereo also contain a pilot tone at 19kHz. More recently digital data has been transmitted by phase modulation of a signal at 57kHz.

This digital information has so far been used for identifying the radio station in a manner which is independent of the actual transmitter and its frequency. This identification of the radio station has been accompanied by information on alternative frequencies for the same radio station. Car radios make use of this to tune automatically to the frequency giving the strongest transmission of the desired radio station.

The transmitted data also includes a time signal and can include a special signal to denote an announcement relating to road traffic. The latter may be used by car radios so that the radio can receive and play the programme on one radio station while monitoring another radio station for a traffic announcement.

This transmission of data by phase modulation of a 57kHz sub carrier is known as the "Radio Data System" (RDS). Standards for RDS information are set by the European Broadcasting Union. It is planned that this transmitted data will subsequently include identification of individual programmes (Programme Item Number) and also identification of programme type. Data in this latter category could for example classify programmes as news, current affairs, rock music, classical music and so on.

According to one aspect of the present invention there is provided an apparatus comprising

means for input of a broadcast programme accompanied by digital data,

memory for recording the programme signal in digital form,

a micro processor arranged to be operable to store a digitized signal in memory and concurrently retrieve a digitized signal from memory and also operable to select programmes for storage or preferential retention in memory by reference to digital data associated with the

programme,

means for converting a digitized signal retrieved from memory back into audio output,

user operable means to give instructions to the microprocessor to make available to the user at least the following functions:

definition of at least one programme to be stored or retained in memory by means of associated data,

retrieval and output of at least one programme from memory whilst storing the current input, enabling the programme to be output with a time delay which may be shorter than the duration of the programme.

Such an apparatus provides for temporary recording of a broadcast programme and also provides for the transmitted digital data to be used to control what is recorded, thus enhancing the effective utilisation of the available memory capacity.

For broadcast programmes which are in analogue form, the apparatus should include means to convert the programme signal from analogue to digital form so that it may be stored.

It is envisaged that programmes may in future be transmitted in digital form, in which case the transmitted digital signal could be stored in memory - possibly after some modification which retained a digital form of signal.

The invention and embodiments of it will now be described in more detail with reference to the accompanying drawings which are given by way of example and are block diagrams in which:

Fig. 1 illustrates the functional parts of a radio receiver as currently envisaged for utilizing RDS information, but which does not embody the invention;

Fig. 2 illustrates a radio receiver embodying the present invention;

Fig. 3 illustrates a recorder embodying the present invention; and

Fig. 4 illustrates a user's display and controls.

Referring first to Fig. 1 of the drawings, this block diagram shows the various sections of a radio receiver making use of RDS information, transmitted in accordance with the standards of the European Broadcasting Union, as such a receiver has hitherto been envisaged. It has a tuner section 10 including at least one tuned circuit to receive broadcast signals. Such circuitry would be largely of the kind currently used in a conventional FM stereo radio receiver but must have sufficient capability to receive the transmitted RDS data as well as the monophonic audio signal, (and probably the pilot tone at 19kHz and the stereo difference signals).

The received signal is passed to an RDS decoder

12 which functions to isolate the digital data (the RDS information) from the audio signal and convert the data from phase modulation of a 57kHz sub carrier to a serial digital data transmission. This is passed through a suitable input/output port to a microprocessor 14 controlled by an operating system stored in ROM 16. Meanwhile the audio signal passes to an audio output section 18 consisting of an audio amplifier and loud speakers.

The microprocessor can change the tuning of the tuned circuit in the receiving circuitry, as indicated by arrow 20. Circuitry 22 measures the strength of a received signal and this is also an input to the microprocessor.

A user can command the microprocessor to tune to a desired station. Such a command causes the microprocessor to repeatedly adjust the tuned circuit until it finds a transmission in which the RDS information denotes the desired station. The RDS information will then include a table of alternative frequencies for the same station and the microprocessor will tune briefly to each of these and assess the signal strength. The microprocessor will finish by tuning to the strongest transmission of the chosen station.

It has been proposed that a radio set of this character could be instructed by the user to "turn itself

on" at the start of a chosen programme. To accomplish this the microprocessor 14 would need to be equipped to disable audio output as indicated at 24. The set would be left switched on with the audio output disabled. The user would input to the microprocessor an identification of the desired programme e.g. the programme item number and the radio station. The microprocessor would then monitor the RDS information from the desired radio station until that RDS information included the selected programme item number. At this point the microprocessor would enable the audio output, and so the radio set would appear to turn itself on at the start of the desired programme.

Another way in which a radio set of this character could be instructed to "turn itself on" is by using the time signal included in the RDS information. The set would be left switched on with the audio output disabled. The user would input the microprocessor an identification of the desired radio station and the time of the desired programme. The microprocessor would then tune to the radio station and enable audio output at the time at which the programme was intended to start.

Controls 26 enabling the user to give commands to the microprocessor 14 could be simple pushbutton switches for tuning, or a key pad, for example a ten digit key pad, for a greater range of functions.

The standards for RDS information envisage that a radio set of this nature would also be provided with a display 28 to show the radio station whose transmission is currently being received. Such a display would reproduce eight alphanumeric characters included in the RDS information. These would be the radio station's name or an abbreviated version of it.

Detailed information on the RDS system can be found in the European Broadcasting Union document Tech 3244E, Specifications of the Radio Data System RDS for VHF/FM Sound Broadcasting (March 1984).

Fig. 2 is a block diagram which illustrates a radio set embodying the present invention. It will be seen that the set has a number of component sections which are analogous to those of the set as illustrated by Fig. 1 but a number of extra sections as well.

The audio signal from the tuner section 10 can pass directly to the audio output as in the set of Fig. 1. However, the audio signal (in this example only the monophonic signal) also goes to an analogue to digital converter 30 which converts this audio signal into digital form. The operating system of the microprocessor enables the microprocessor to store the digitized signal in a random access memory 32. It is also able to retrieve stored signal from this memory and pass the retrieved

signal to a digital analogue converter 34 from which the reconstituted analogue signal is passed to the audio output section 18 consisting of audio amplifiers and loud speakers.

Conversion of an audio analogue signal to digital form is a known technique. It requires sampling the audio signal at frequent intervals.

For this embodiment of the invention it is envisaged that the sampling frequency could be 22 kHz, sampling on a scale defined by 8 data bits (but other sampling frequencies and scales of definition are within the scope of the invention). This would give a quality of reproduction similar to that currently achieved by relatively low cost audio amplifiers and loud speakers as customarily used in portable radio sets. With sampling in this manner a memory of 80 Mbyte would be sufficient to provide for 1 hour of recorded signal.

It is envisaged that the memory 32 will be provided by dynamic RAM as conventionally used for the random access memory of computers. However it is within the scope of the invention to employ other forms of memory giving random access.

The memory capacity can be increased or the requirement for memory reduced by compressing the digitized

signal. This entails manipulating the signal in accordance with an algorithm and subsequently manipulating the retrieved signal to recover the original digital signal with some degradation. Compression of a digital signal is a known technique.

The 22kHz sampling frequency proposed above is sufficiently low that memory access for storage (writing to memory) could alternate many times per second with access for retrieval (reading from memory). The result would be that storage in memory of a broadcast programme could take place concurrently with retrieval of previously stored programme material, quite possibly an earlier part of the same programme.

If necessary, techniques which are known in the field of computer design for accelerating the speed of access to memory could be utilised. One such technique is so called direct memory access in which data transfer into and out of memory does not pass through the microprocessor but instead passes through a separate chip controlling memory access under control of the microprocessor.

It may also prove desirable to use so-called dual port RAM chips which have the capability of being written to and read from simultaneously.

It will be apparent that the radio set

illustrated by Fig. 2 has at least one more mode of operation than those available with the set of Fig. 1.

Like the set illustrated by Fig. 1 it can operate with the received signal being passed directly to the audio output. Also in common with the set of Fig. 1 it can operate with the audio output disabled and the microprocessor monitoring a chosen station for the start of the programme identified by a programme item number included in the RDS information, or waiting until a predetermined time at which the programme is scheduled to start.

A third possibility, however, is a time shifted mode of operation. In this mode the direct audio output is disabled. Instead the received signal is stored in memory a digitized form while the digitized signal is withdrawn from memory after a period of delay, converted back to an analogue signal and passed to the audio output. This gives reproduction of the transmitted programme with a time shift. As long as the time shift is less than the memory capacity, reproduction of the programme can be maintained indefinitely by arranging that the digitized signal which is stored in memory overwrites information which has already been retrieved and so is no longer required.

For example, if the memory has sufficient capacity to store 15 minutes transmission and the signal is

being reproduced with a time shift of 10 minutes, the data bits stored at a particular address in memory will be retrieved 10 minutes later for replay, and only overwritten by fresh data 5 minutes after that.

The radio set of Fig. 2 provides functions beyond those available from the set of Fig. 1.

If the set is operating with the received signal being passed direct to the audio output (reproduction in real time) and the user is interrupted, the user can give a "pause command". The set then ceases to reproduce the programme in real time and instead stores the signal in memory until the user gives a "continue command". After this the set reproduces the programme with a time shift corresponding to the interval between the "pause" and "continue" commands. In this way the user can avoid missing the portion of programme which coincides with the period of the interruption. Such commands could also be used while the set is reproducing a programme with time shift, and would serve to lengthen the time shift.

Analogously the microprocessor could be instructed to jump backwards for a short period of time, and then reproduce the programme with time shift (or an increased time shift). The effect would be to repeat the programme portion within the backwards jump. A use of this would be to repeat something which has just been heard

indistinctly.

The microprocessor can be instructed to record a chosen programme. The microprocessor waits until a predetermined time or else monitors a selected station until the appropriate programme item number (or possibly other programme identification contained in the RDS information) appears in the RDS information, as described for Fig. 1. However, the microprocessor then stores the digitized programme as well as or instead of enabling immediate audio output.

Retrieval of the programme will take place when chosen by the user. This may be after the programme has finished but may take place with time shift while the later parts of the programme are still being transmitted.

As an illustration of the application of this function, assume that a user wishes to wake up at about 7am, and be sure to hear the 7am news broadcast. The radio set is instructed to monitor the station until the programme item number for the 7am news broadcast appears in the RDS information, then start recording. If the user wakes up a few minutes after 7am, part way though the broadcast, the user gives a command to reproduce the news broadcast with time shift and so does not miss the beginning of the broadcast.

Another function is to record the latest broadcast of a defined type. The user would instruct the microprocessor with the identity of the radio station and the desired programme type. The microprocessor monitors the station until the RDS information contains identification of the programme type. It then records this programme until the programme identification changes again. A subsequent programme would only overwrite the recorded programme if it is also of the same type.

An illustration of this is provided by use to keep a recording of the latest news bulletin from a chosen station. The radio set monitors the station until a news bulletin is identified by a programme type code in the RDS information. The news bulletin (duration 10 minutes) is recorded and is not overwritten by the next programme (which is music) but it is overwritten by the next news bulletin.

This function could also be implemented by a radio which does not have the ability to retrieve from memory while concurrently storing in memory. Such a radio could provide the novel function of storing the most recent news bulletin from a radio station but prohibit retrieval from memory during any period while a later news bulletin is being stored in memory.

For such a radio, random access memory would not

be essential, although solid state memory would be attractive in order to avoid moving parts.

There are two ways in which the microprocessor can use RDS information to select a programme to be held in the memory. One way is that a programme is simply ignored unless its RDS information satisfies the defined criteria as to transmission time, programme type or programme item number. The other way, which is preferred, is that all programme material which is received is also recorded in so far as memory capacity is available, but a programme whose RDS information satisfies defined criteria is protected from being overwritten.

When a user makes use of the various functions which are available the use of one function may reduce the availability of others either because of the organisation chosen for the radio set or because of limitations on memory capacity. For example, a radio set could conceivably be organised so that if it was instructed to record a programme defined by transmission time, or programme type or programme item number, then the entire memory would be used for that purpose and the facility to time shift back for a few minutes during a current live programme would be temporarily unavailable.

However, if the microprocessor uses RDS information in the preferred manner, all programme material

which is received is recorded for a time in whatever memory space is available so that the "pause command" is always available. If the material which is recorded includes a programme which has been selected by programme type, programme item number or transmission time, this will be retained in memory for as long as the user chooses, thereby reducing the amount of memory available for transient recording of the currently received programme material. The effect then is that the retention of a programme does not exclude use of the "pause command" but does reduce the length of the time shift available through use of the pause command.

Preferably the microprocessor maintains a record of RDS information associated with programme material held in the memory 32. This can allow a user to instruct the microprocessor to jump back to the start of the current programme, identified by a change in the programme item number (or other RDS information).

Another possible function is that while a programme is being reproduced though the audio output the user can give a command to retain the current programme for subsequent replay. The microprocessor would then retain in memory the whole of the programme including the part which has already been reproduced. The beginning and end of the programme would be defined by changes in the programme item number or other RDS information associated with that

programme.

Although it is preferred that the apparatus emobdying this invention is a complete radio receiver with a tuner section and an audio output section it is conceivable that the invention would be embodied in a separate recorder to be used with a separate radio receiver. Such an arrangement is illustrated by Fig. 3 in which the means for input is simply a socket 40 for connection to a separate radio receiver and the means for audio output is simply an output socket 42 for connection to a separate audio amplifier and loud speakers (which may or may not be integral with the radio receiver).

In this case the microprocessor and the RDS information cannot be used by the user for tuning the radio set but the other functions referred to above are available in the same manner as described previously.

Fig. 4 illustrates a more elaborate form of display, together with user operable controls by which a user can instruct functions as discussed above wioth reference to Fig 2. This form of display and controls envisages that the RDS information transmitted will include additional information beyond that referred to previously (identification of radio station, programme item number and programme type together with a time signal).

This additional RDS information gives the name of the programme currently being transmitted, the name of the current item within the current programme and a schedule of programmes which are to be transmitted within a future time period (say the subsequent 12 hours).

The microprocessor's operating system is arranged to receive this information and maintain a directory, in a relatively small amount of memory, of the names of the radio stations which can be received with acceptable signal strength, the programmes which those stations intend to transmit within the subsequent time period (say 12 hours) and also a directory of the names of programmes and items within programmes stored currently in its memory.

The device has a display 50 capable of providing 10 lines of text with 30 characters in each line. This display could be provided by a small cathode ray tube display or by a bit-mapped LCD display or other flat screen display technology.

The user-operable controls are buttons 52-76 arranged around the display screen 50. Button 54 is used for selecting a radio station. When this button is pressed the microprocessor displays on the screen 50 a list of the radio stations which are receivable. The buttons 64,66 can be used to move a cursor up or down the list and the button 68 selects whichever station has the cursor beside it.

Once a station has been selected the display 50 changes to show the station's name, the name of the current programme being transmitted by that station and the name of the item in that programme.

If the button 52 is pressed the programme from the station which is currently selected is reproduced live.

At all times the programme which is currently being received is stored in the memory. This has the capacity to hold 60 minutes of programme material. If the whole memory capacity is available the most recent 60 minutes of received programme material is held in the memory. If part of the memory has already been used for something else then the remaining memory is used to hold received programme material. The operating system of the microprocessor is arranged so that at least the most recent 30 minutes of programme material received is held in the memory.

Button 56 is used for selecting material by category. If this button is pressed the display shows the available categories for example news, current affairs, serious music, pop music. A cursor appears alongside this list and can be moved to an item on the display with the buttons 64 and 66 after which that category is selected with the button 68. This has the effect of causing the

microprocessor to display a list of currently receivable programmes of that programme type as indicated by the programme type given in the RDS information associated with each programme. The user can then select one of these programmes with the buttons 64-68. The radio set will then tune to the radio station which is transmitting that programme, and change the display to show the radio station and the name of the programme being received.

If the button 58 is pressed the display changes to give a list of the items received during the last 30 minutes (or longer time if memory capacity was available) and the display also has a cursor at the point currently being played. If for example the radio set is currently reproducing the received signal in real time the cursor will be at the head of this list. The user can move back to an earlier item by using the buttons 64 and 66 to move the cursor in the list and then select that item by pressing the button 68. The radio then reproduces that item from memory (so that the programme concerned is being reproduced with time shift) while continuing to record the programme material from the station to which the set is currently tuned.

At any time when the display shows the programme item currently being reproduced the button 70 can be used to give a "pause" command, the button 72 can be used to give a "continue" command and the button 74 can be used to

instruct the microprocessor to retain the programme item indefinitely (provided there is memory space available) without being overwritten. The beginning of the item which has already been reproduced and the end of the item which has not yet been reproduced are both defined by changes in the associated RDS information.

If the button 62 is pressed the display gives a list of the programmes or programme items which are being retained indefinitely. Items in the list can be selected with the buttons 64,66 and then reproduced through the audio output by pressing button 68 or deleted by pressing button 76.

If the user wishes to instruct the radio set to record some future item the user first selects the radio station which will transmit the item and then presses button 60. This causes the microprocessor to display a list of programmes to be transmitted from that radio station. The buttons 64 and 66 are used to move the cursor on the display to the programme desired after which it is selected by pressing the button 68.

The directory maintained in memory by the microprocessor will contain not only the name of the selected programme but also the associated programme item number. The radio set then monitors the station concerned for the appearance of that programme item number in the RDS

information, as described above, and when that programme commences the radio set receives that programme and stores it in memory, as described above.

When a future item is selected to be recorded, the buttons 74,76 can be used to choose how the programme is handled when it is eventually received. If button 74 is pressed before pressing the select button 68 the programme is held in memory indefinitely and if button 76 is pressed before pressing the select button 68 the audio output is disabled while the programme is being received.

A display of this character can use known circuitry and software for microprocessor driven displays and readable keys. All the connections to the microprocessor, including those referred to in discussion of figures 1 and 2 can pass through input/output ports or buffers as is conventional in the technology of microprocessors.

It is proposed above that the digitisation of an audio signal would be carried out in a manner giving a quality which is good but not the best available. This however is a matter of choice and it is within the scope of the invention to use a higher or lower quality of reproduction as may be desired. In particular it is within the scope of the invention to digitise and store a monophonic audio signal, or stereo signals.

CLAIMS:

1. An apparatus comprising

means for input of a broadcast programme accompanied by digital data,

random access memory for recording the programme signal in digital form,

a micro processor arranged to be operable to store a digitized signal in memory and concurrently retrieve a digitized signal from memory and also operable to select programmes for storage or preferential retention in memory by reference to digital data associated with the programme,

means for converting a digitized signal retrieved from memory back into audio output,

user operable means to give instructions to the microprocessor to provide at least the following functions:

definition of a programme to be stored or retained in memory by means of associated data,

retrieval and output of a programme from memory whilst storing the current input, enabling the programme to be reproduced with a time delay.

2. Apparatus as claimed in claim 1 including means to convert a programme signal in analogue form to digital form.

3. Apparatus as claimed in claim 1 or claim 2 including means for compressing the digitised signal prior to storage in memory.

4. Apparatus as claimed in any one of claims 1 to 3 which is a radio receiver and the means for input of a programme is means for reception of a radio broadcast and includes a tuned circuit.

5. Apparatus as claimed in any one of the preceding claims wherein the user operable functions include instructing the microprocessor to halt reproduction of a programme in real time and later to continue reproduction by retrieval from memory while continuing to store in memory.

6. Apparatus as claimed in any one of the preceding claims wherein the user operable functions include defining a programme to be stored or retained in memory by scheduled transmission time.

7. Apparatus as claimed in any one of the preceding claims wherein the user operable functions include storing in memory a programme of a type defined by associated data, and automatically replacing it by a later programme of the same defined type.

8. Apparatus as claimed in any one of the preceding

claims arranged to store all received programmes in the memory and to retain a programme defined by associated data in preference to programmes received thereafter.

9. Apparatus as claimed in claim 8 wherein the user operable means can instruct the microprocessor to retain in memory a programme or portion thereof which is currently being reproduced, the microprocessor being arranged to identify at least the beginning of the programme or portion by a change in associated data.

10. Apparatus as claimed in any one of the preceding claims wherein the microprocessor is arranged to maintain a record of programmes or programme portions held in memory and to use this record for retrieving programmes.

11. An apparatus comprising

means for input of a broadcast programme accompanied by digital data,

memory for recording the programme signal,

a micro processor arranged to be operable to store the signal in memory and retrieve a signal from memory and also operable to select programmes for storage or preferential retention in memory by reference to digital data associated with the programme,

means for converting a digitized signal retrieved from memory back into audio output,

user operable means to give instructions to the

microprocessor to provide at least the following functions:

definition of a programme to be stored or retained in memory by means of associated data,

automatically replacing a stored programme with a later programme of the same type as defined by associated data,

retrieval and output of a stored programme from memory.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number
GB 9113856.0

Relevant Technical fields

(i) UK Cl (Edition K) H3Q (QBCT, QCD)

(ii) Int Cl (Edition 5) H04B 1/36

Databases (see over)

(i) UK Patent Office

(ii) ONLINE DATABASE: WPI

Search Examiner
D MIDGLEY

Date of Search
16 OCTOBER 1992

Documents considered relevant following a search in respect of claims 1-10

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
Y	EP 0189622 A1 (MATHEWS) whole document	1-10
Y	WO 91/07029 A1 (BOSCH) whole document	"
Y	WO 89/12881 A1 (BOSCH) whole document	"
X	WO 87/04309 A1 (MOTOROLA) see for example, page 5, lines 10-20	"

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family, corresponding document.

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases [illegible] are also listed periodically in the Official Journal (Patents).